Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

0631015779

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **9** printed pages and **3** blank pages.

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1 The enzyme lactase hydrolyses the disaccharide lactose to glucose and galactose. This enzyme is produced in the small intestine of mammals and by some fungi and bacteria.

Fig. 1.1 shows this reaction.

$$\underset{C_{12}H_{22}O_{11}}{\text{lactose}} + \underset{H_2O}{\text{water}} \xrightleftharpoons{\text{lactase}} \underset{C_6H_{12}O_6}{\text{glucose}} + \underset{C_6H_{12}O_6}{\text{galactose}}$$

Fig. 1.1

The Michaelis-Menten constant, K_m, shows the affinity of an enzyme for its substrate. The lower the K_m the greater the affinity.

A student carried out an investigation to find the K_m of the enzyme lactase at different pH values commonly found in organisms.

The student:

- made 1 dm^3 of 0.15 mol dm^{-3} solution of lactose, molar mass 342.3 g mol^{-1}
- used proportional dilution to make a total of five lactose solutions from 0.15 mol dm^{-3} stock solution, each of 500 cm^3
- used 1 g per 100 cm^3 lactase solution
- used a glucose biosensor to measure the initial rate of reaction at each pH. A glucose biosensor measures glucose in mmol dm^{-3}.

Fig. 1.2 shows the experimental set-up.

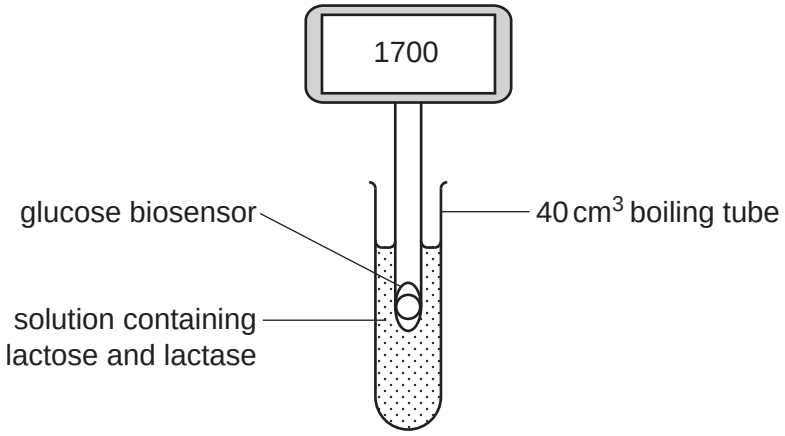


Fig. 1.2

(a) (i) Describe how the student could make 1 dm^3 of 0.15 mol dm^{-3} solution of lactose.

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(ii) Describe how the student made a further four solutions of lactose by proportional dilution.

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(b) (i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....
[2]

(ii) Suggest a suitable control for this investigation.

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..... [1]

(iii) Describe a method that the student could use to find the K_m of lactase at different pH values. The solutions were made as described in **(a) (i)** and **(a) (ii)** and the apparatus shown in Fig. 1.2 was used.

Your method should be set out in a logical way and be detailed enough to let another person follow it.

You should **not** include details of how to make the lactose or lactase solutions.

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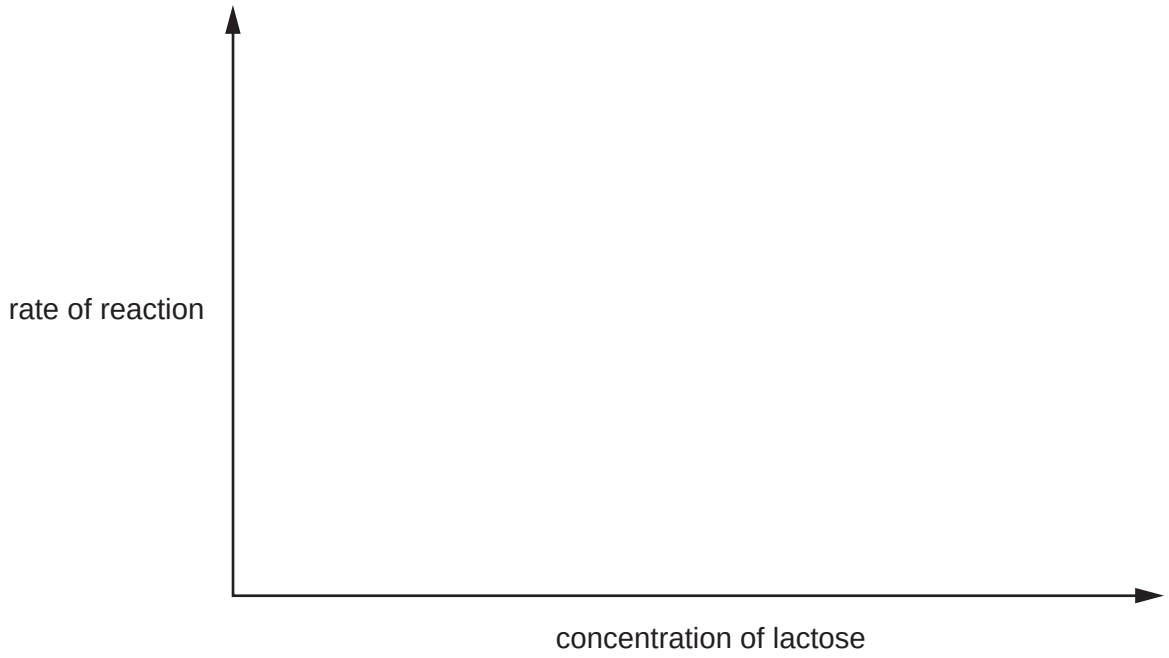
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(c) (i) Complete Fig. 1.3 by sketching a graph to show the effect of substrate concentration at one pH on the initial rate of reaction.

Indicate on your graph how the student could find the K_m value of lactase at that pH.



[4]

Fig. 1.3

(ii) Table 1.1 shows the results that the student obtained for K_m at different pH values.

Table 1.1

pH	**A**	**B**	**C**	**D**	**E**
K_m / arbitrary units	0.216	0.112	0.166	0.178	0.324

State which of these pH values, **A** to **E**, is closest to the likely optimum pH of lactase.

Explain your answer.

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..... [2]

[Total: 19]

2 In some countries crops are irrigated using water containing salt (sodium chloride).
This makes the soil saline (salty) which means it contains sufficient neutral soluble salts to reduce the growth and yield of most crop plants.

The responses of crop plants to salinity vary between two extremes:

- sensitive – plants show the greatest reduction in growth and yield
- tolerant – plants show the least reduction in growth and yield.

Agricultural research organisations have investigated the effect of irrigation with salt solutions on the yields of a variety of crop plants. The data collected allowed researchers to determine, for each crop, the concentration of salt solution at which yield is reduced by 50%. From the data recommendations could be made about which crops were most suitable to grow in saline soils.

Table 2.1 shows the crops tested.

Table 2.1

grasses (monocotyledons)	**broad leaf crops (dicotyledons)**
human consumption	
Triticum aestivum bread wheat	*Solanum tuberosum* Irish potato
Hordeum vulgare barley	*Brassica oleracea* cabbage
	Spinacia oleracea spinach
animal grazing	
Festuca arundinacea tall fescue	*Medicago sativa* alfalfa
Agropyron cristatum crested wheatgrass	

- Seeds were germinated in salt-free conditions.
- Young plants were planted into fields that were divided into standard test plots of the same area for each crop.
- Each field was irrigated regularly with a different concentration of salt solution.
- Control plots were irrigated with salt-free water.
- Each crop was grown to maturity and harvested.
- The dry mass of the edible parts of the plants was measured to find the yield for each concentration of salt solution.

(a) (i) Identify **one** variable that could be standardised once the young plants are in the test plots in the fields.

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..... [1]

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(ii) Suggest **one** other variable that **cannot** be standardised once the young plants are in the test plots in the fields.

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(b) Suggest why the researchers used dry mass to estimate the yield of the different crops.

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(c) The data collected by the researchers allowed them to determine, for each crop, the concentration of salt solution at which yield is reduced by 50%.

Explain how the researchers determined the concentration of salt at which yield is reduced by 50%.

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..... [2]

Fig. 2.1 shows the results of this investigation.

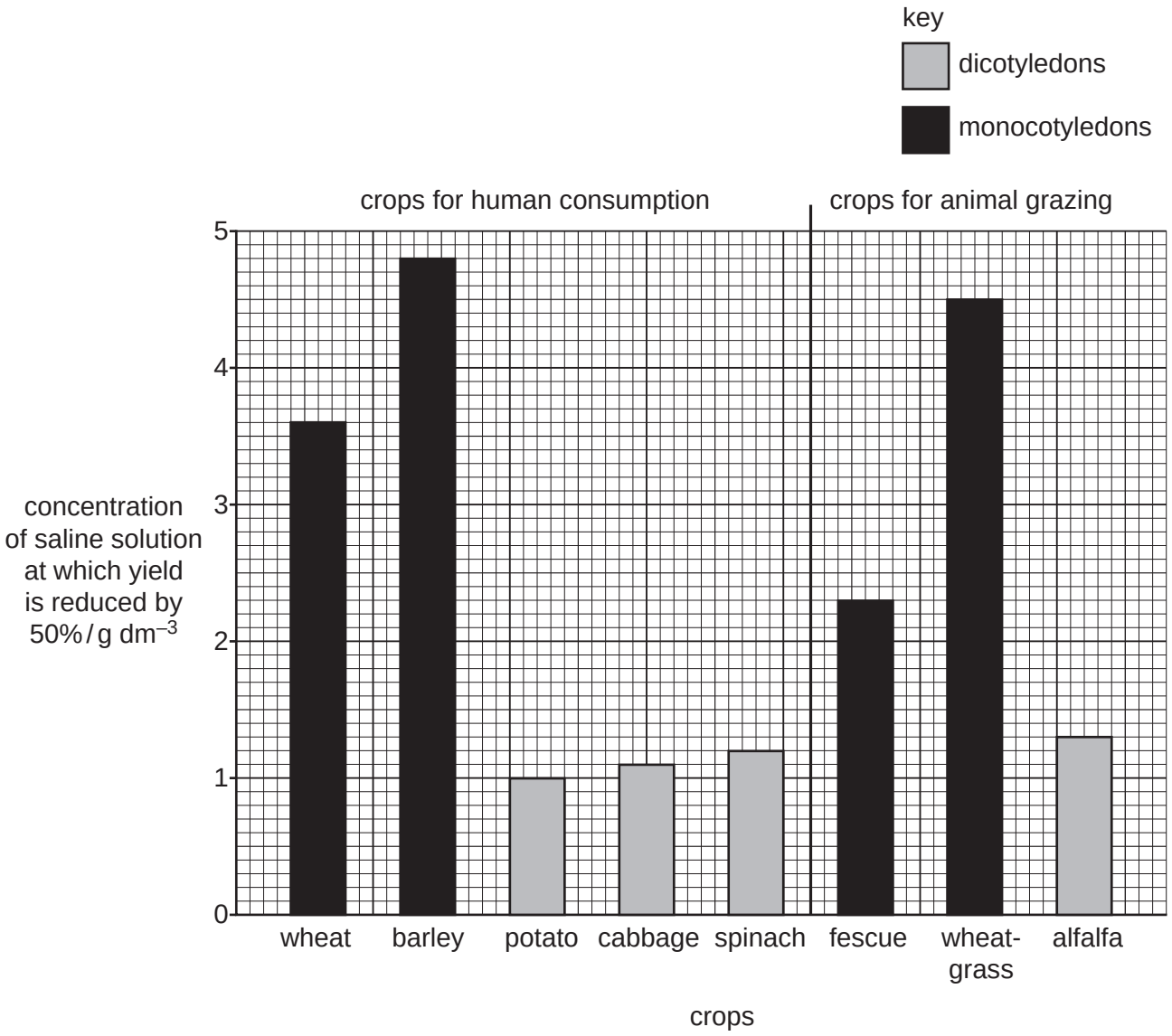


Fig. 2.1

(d) State **three** conclusions that can be made about the effect on the yield of these crops when irrigated with salt solutions.

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..... [3]

(e) Based on these results the agricultural organisations published recommendations to help farmers choose which crops to grow in saline soils.

However, farmers in different parts of the world who followed these recommendations did not obtain the yields expected.

Suggest two reasons for this.

1 .....

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2 .....

..... [2]

[Total: 11]

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